

FIG. 1B

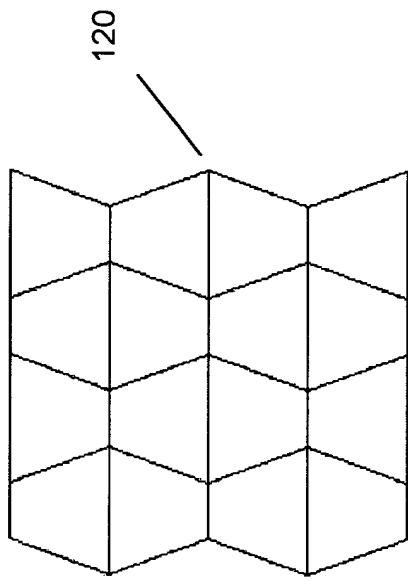
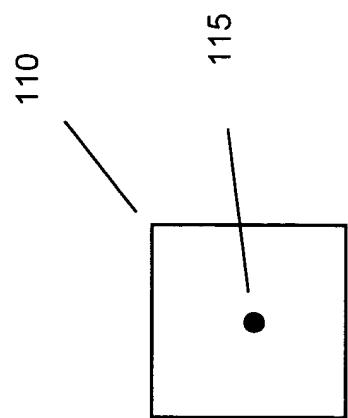


FIG. 1A



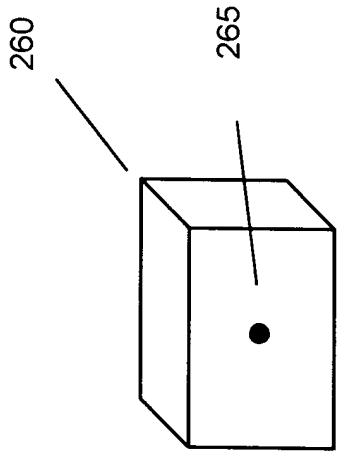


FIG. 2A

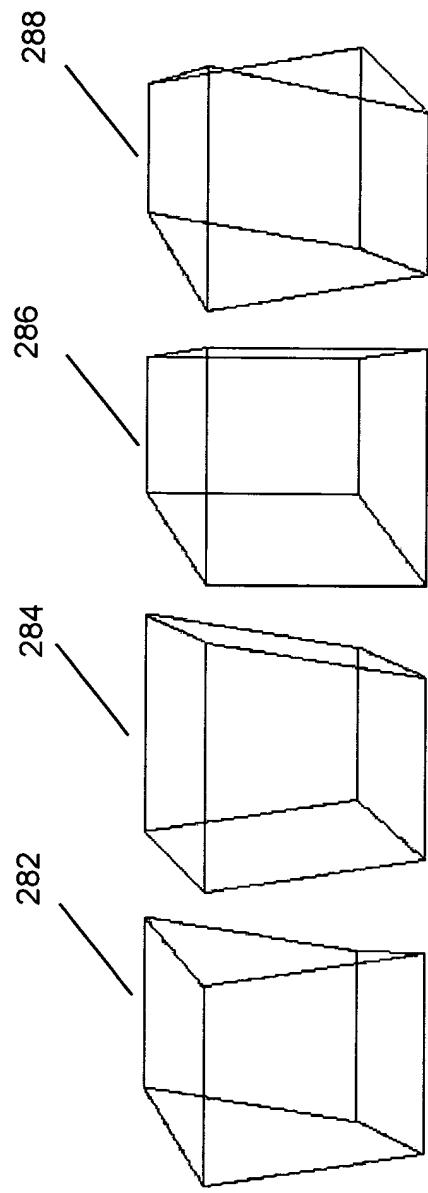
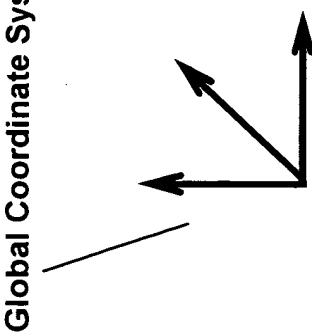
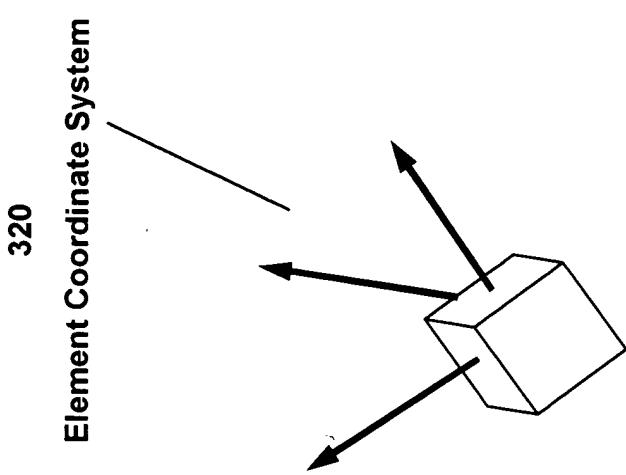


FIG. 2B

FIG. 3



310
Global Coordinate System



320
Element Coordinate System

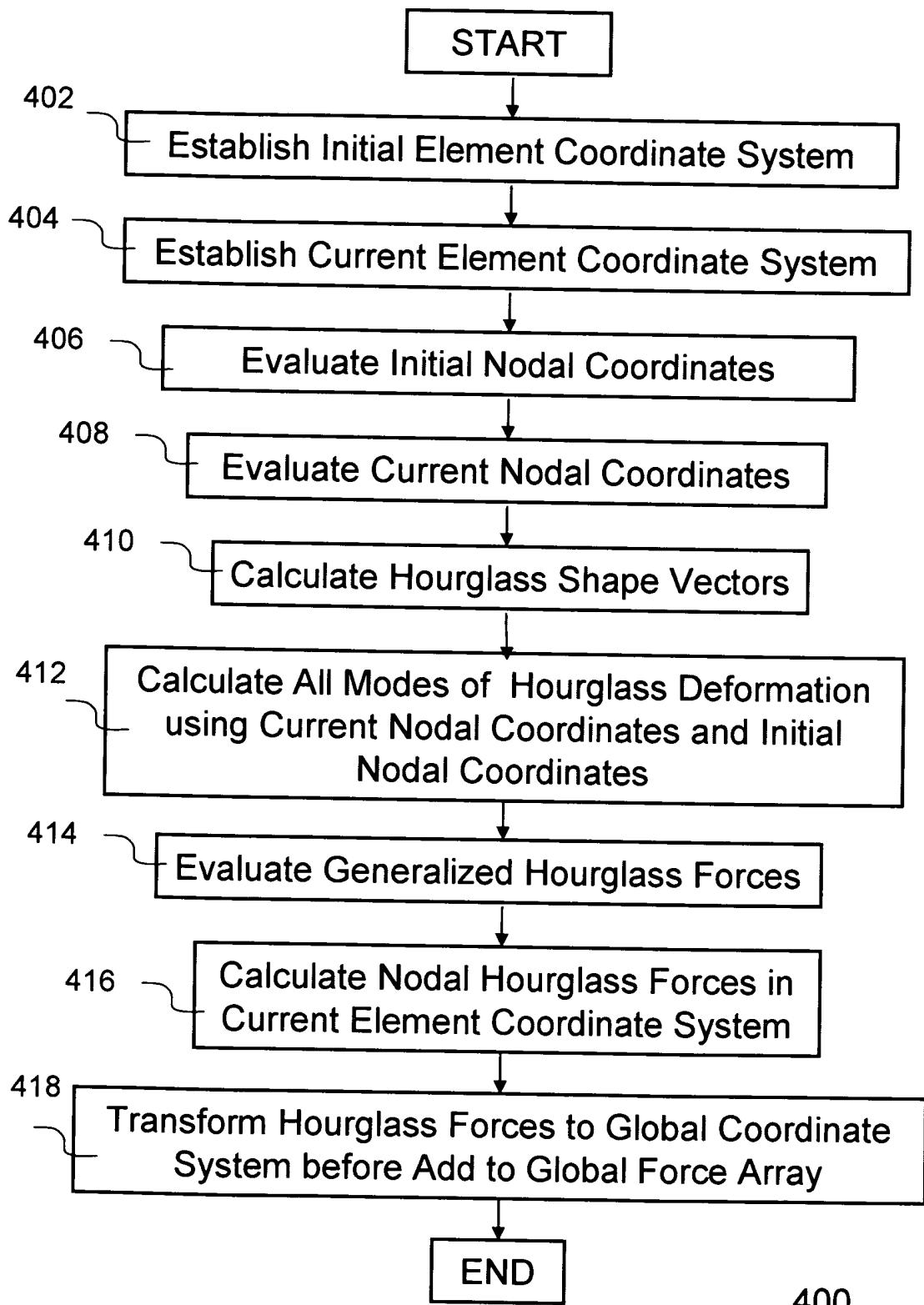


FIG. 4A

400

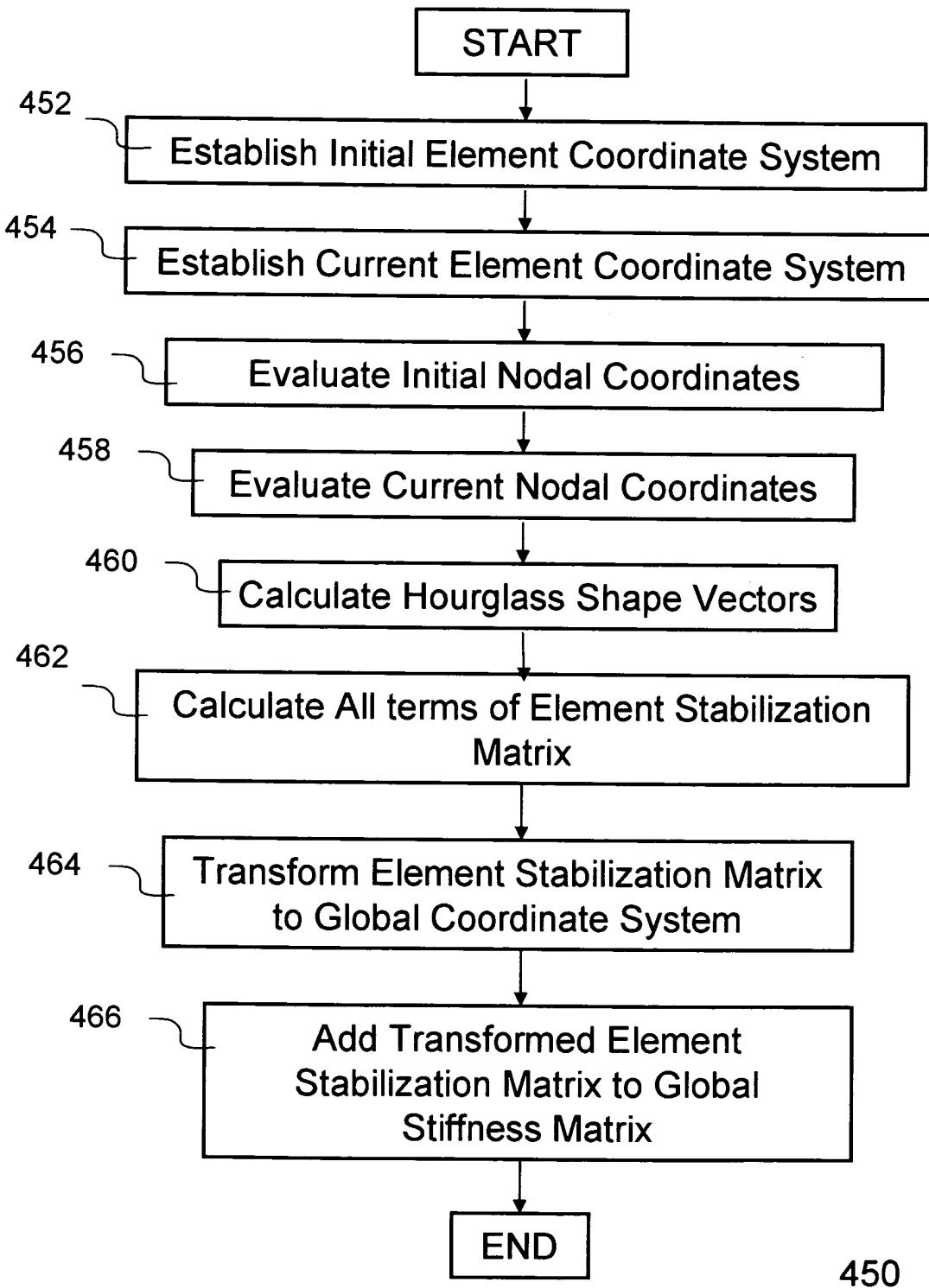


FIG. 4B

$$\boxed{\bar{\gamma}_{\alpha I} = \Gamma_{\alpha I} - \sum_{i=1}^3 \left(\overline{B}_{il} \sum_{J=1}^8 \bar{X}_{iJ} \Gamma_{\alpha J} \right) \quad 510}$$

$$\boxed{\hat{g}_{i\alpha} = \sum_{J=1}^8 \bar{\gamma}_{\alpha J} (\hat{x}_{iJ} - \bar{X}_{iJ}) \quad 520}$$

FIG. 5A

$$\left. \begin{aligned} \hat{G}_{ii} &= \mu \left[\left(\bar{H}_{jj} + \bar{H}_{kk} \right) \hat{g}_{ii} + \bar{H}_{ij} \hat{g}_{jj} + \bar{H}_{ik} \hat{g}_{kk} \right] \\ \hat{G}_{ij} &= \frac{2\mu}{1-\nu} \left[\bar{H}_{ii} \hat{g}_{ji} + \nu \bar{H}_{ij} \hat{g}_{ij} \right] \\ \hat{G}_{i4} &= \frac{\mu}{3} \left[\frac{2}{(1-\nu)(1-2\nu)} \bar{H}_{ii} + \bar{H}_{jj} + \bar{H}_{kk} \right] \hat{g}_{i4} \end{aligned} \right\} 530$$

$$\begin{aligned} \bar{H}_{ii} &= \frac{1}{3} \frac{\sum_{J=1}^8 \xi_{jJ} \bar{X}_{jJ} \sum_{J=1}^8 \xi_{kJ} \bar{X}_{kJ}}{\sum_{J=1}^8 \xi_{iJ} \bar{X}_{iJ}} \\ \bar{H}_{ij} &= \frac{1}{3} \sum_{J=1}^8 \xi_{kJ} \bar{X}_{kJ} \end{aligned} \quad 535$$

$$\hat{f}_{i\alpha J} = \hat{G}_{i\alpha} \bar{\gamma}_{\alpha J} \quad 540$$

FIG. 5B

580

J	1	2	3	4	5	6	7	8
Γ_{1J}	1	-1	1	-1	1	-1	1	-1
Γ_{2J}	-1	1	-1	-1	-1	-1	1	1
Γ_{3J}	1	-1	-1	1	-1	1	1	-1
Γ_{4J}	1	-1	1	-1	-1	1	-1	1

FIG. 5C

585

J	1	2	3	4	5	6	7	8
ξ_{1J}	-1	1	1	-1	-1	1	1	-1
ξ_{2J}	-1	-1	1	1	-1	-1	1	1
ξ_{3J}	-1	-1	-1	-1	1	1	1	1

FIG. 5D

FIG. 5E

i	j	k
1	2	3
1	3	2
2	3	1
2	1	3
3	1	2
3	2	1

590

$$\boldsymbol{\gamma}_j = \left\{ \begin{array}{l} \bar{\boldsymbol{\gamma}}_{j1} \\ \bar{\boldsymbol{\gamma}}_{j2} \\ \bar{\boldsymbol{\gamma}}_{j3} \\ \bar{\boldsymbol{\gamma}}_{j4} \\ \bar{\boldsymbol{\gamma}}_{j5} \\ \bar{\boldsymbol{\gamma}}_{j6} \\ \bar{\boldsymbol{\gamma}}_{j7} \\ \bar{\boldsymbol{\gamma}}_{j8} \end{array} \right\}$$

$$\boldsymbol{\gamma}_j^T = \left\{ \bar{\boldsymbol{\gamma}}_{j1}, \bar{\boldsymbol{\gamma}}_{j2}, \bar{\boldsymbol{\gamma}}_{j3}, \bar{\boldsymbol{\gamma}}_{j4}, \bar{\boldsymbol{\gamma}}_{j5}, \bar{\boldsymbol{\gamma}}_{j6}, \bar{\boldsymbol{\gamma}}_{j7}, \bar{\boldsymbol{\gamma}}_{j8} \right\}$$

$$j = 1, 2, 3, 4$$

$$\begin{aligned}
k_{11} &= \mu H_{11} \left[\frac{2}{1-\nu} (\boldsymbol{\gamma}_2 \boldsymbol{\gamma}_2^T + \boldsymbol{\gamma}_3 \boldsymbol{\gamma}_3^T) + \frac{2(1-\nu)}{3(1-2\nu)} \boldsymbol{\gamma}_4 \boldsymbol{\gamma}_4^T \right] \\
&\quad + \mu (H_{22} + H_{33}) \left(\boldsymbol{\gamma}_1 \boldsymbol{\gamma}_1^T + \frac{1}{3} \boldsymbol{\gamma}_4 \boldsymbol{\gamma}_4^T \right) \\
k_{22} &= \mu H_{22} \left[\frac{2}{1-\nu} (\boldsymbol{\gamma}_1 \boldsymbol{\gamma}_1^T + \boldsymbol{\gamma}_3 \boldsymbol{\gamma}_3^T) + \frac{2(1-\nu)}{3(1-2\nu)} \boldsymbol{\gamma}_4 \boldsymbol{\gamma}_4^T \right] \\
&\quad + \mu (H_{11} + H_{33}) \left(\boldsymbol{\gamma}_2 \boldsymbol{\gamma}_2^T + \frac{1}{3} \boldsymbol{\gamma}_4 \boldsymbol{\gamma}_4^T \right) \\
k_{33} &= \mu H_{33} \left[\frac{2}{1-\nu} (\boldsymbol{\gamma}_1 \boldsymbol{\gamma}_1^T + \boldsymbol{\gamma}_2 \boldsymbol{\gamma}_2^T) + \frac{2(1-\nu)}{3(1-2\nu)} \boldsymbol{\gamma}_4 \boldsymbol{\gamma}_4^T \right] \\
&\quad + \mu (H_{11} + H_{22}) \left(\boldsymbol{\gamma}_3 \boldsymbol{\gamma}_3^T + \frac{1}{3} \boldsymbol{\gamma}_4 \boldsymbol{\gamma}_4^T \right)
\end{aligned}$$

$$k_{12} = \mu H_{12} \left[\frac{2\nu}{1-\nu} \boldsymbol{\gamma}_2 \boldsymbol{\gamma}_1^T + \boldsymbol{\gamma}_1 \boldsymbol{\gamma}_2^T \right]$$

$$k_{13} = \mu H_{13} \left[\frac{2\nu}{1-\nu} \boldsymbol{\gamma}_3 \boldsymbol{\gamma}_1^T + \boldsymbol{\gamma}_1 \boldsymbol{\gamma}_3^T \right]$$

$$k_{23} = \mu H_{23} \left[\frac{2\nu}{1-\nu} \boldsymbol{\gamma}_3 \boldsymbol{\gamma}_2^T + \boldsymbol{\gamma}_2 \boldsymbol{\gamma}_3^T \right]$$

$$k_{21} = k_{12}^T$$

$$k_{31} = k_{13}^T$$

$$k_{32} = k_{23}^T$$

596

FIG. 5H

